

Machine with Personality

Persuasive Chatbot

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Abstract

Persuading someone to do something is a task that most of our lifetime will experience. Using human resources to do such a task is time consumable and inefficient. However, building and implementing a persuasive chatbot can negate such a downside of using human resources. Our project is based on this intuition and focuses on making a donation, and we believe by adding a personality aspect of the target will increase the chance of success. Hence, by using human samples of persuading different personality people datasets, we developed a python scripted chatbot that will interact with the user and do the persuading job of donation.

1 Introduction

When humans try to persuade someone, they may try many different topics to lead to the final goal of persuading them. And this task includes so much work and it requires time to do. Merely relying on a human to do such a task is not a good way to solve the persuading task.

Another aspect when we think about persuasion is the target's personalities. Different personalities may lead to different ways of persuading people. For example, an extrovert will talk more frequently and radically compared to an introvert. Thus, considering the number of different personalities, a human persuader will need so much experience to fully understand how to persuade different people by their personalities.

These difficulties make the task of persuading others hard to solve for human persuaders. However, if a technology that makes a chatbot can communicate with the user and then try to persuade the person to do something that exists, those difficulties will no longer be a problem. The time consumed for those human persuaders to gain experience will be directly inputted to our database and thus being utilized directly and effectively; the chatbot also can talk to thousands of people at the same time while still not being tired of keeping doing the same task for a long period.

For a specific area of interest, we decided to go with the donation part and develop a chatbot that tries to persuade the user to donate. Our goal of making such a chatbot is to build an interactive chatbot that utilizes the dataset of conversational records between different personalities target users and the human persuaders to train a model that will understand what the input means and then output a human-readable language to persuade the user. By analyzing the results of how many people can be donated afterward, we will see the results being effective or not.

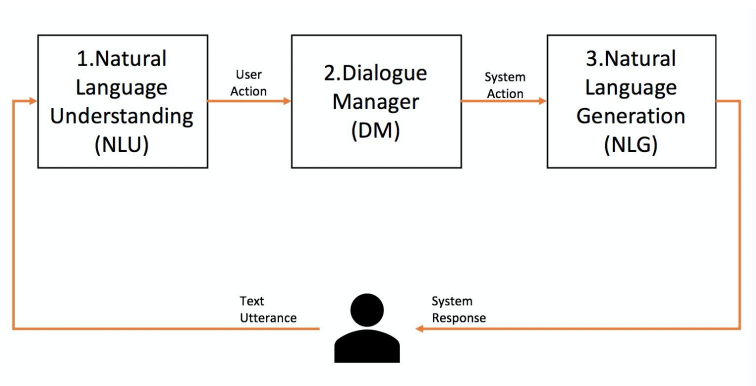
2 Related Work

This research combines two areas of ongoing research.

- Persuasive Chatbot focused on persuading people to donate to save children
- Seq2Seq Model in NLP

2.1 Persuasive Chatbot

Chatbot in a certain area is very common now, like customer service. But the intelligent persuasive conversational agents are still pretty new. Xuewei et al(2019)[1] collected data between two users, one persuading the other to donate to save children, and finished the natural language understanding, predicted the label of every sentence from persuadee. And in 2020, the same team published a new paper(2020)[2] building their own agenda-based persuasive conversational context. They followed the structure of Natural Language Understanding, Dialogue Manager, and then Natural Language Generation. In their NLG process, they used the template-based method that had a fixed set of human-written templates for each dialogue acts and retrieval-based method that generated response from an existing corpus.



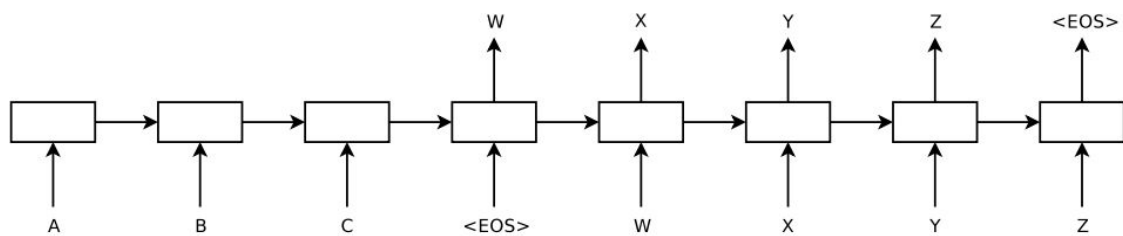
Our team found that the above method works well for the target to donate to children, but it is very restricted to certain datasets. When the dataset has been changed, we need to change their model a lot to fit the new data because it needs new notation for every sentence. Therefore, we decided to not use the above model.

2.2 Seq2Seq Model

Seq2Seq Model was introduced by Ilya et al(2014)[3] in 2014, which proved that sequence to sequence learning with neural networks worked very well for machine translation.

To date, there exist many other types of research that have proved that the Seq2Seq model can improve the results of most NLP problems.

Our team applied the Seq2Seq model to the persuasive conversational dialogue. For every input from the user, our model would generate the response word by word, which means that it is likely that there would be some responses that do not exist in the original dataset. One big advantage of our model is that it is easier to apply our model to other persuasion tasks other than making some donations to children.



3 Data

The dataset we use is mainly provided by a previous work paper done by Zhou Yu. In this dataset, they developed a survey to firstly find out the personalities of these volunteers. With some mixed questions like the Big-Five personality traits, the Moral Foundations endorsement, the Schwartz Portrait Value, and the Decision-Making style, it provided a full detailed perspective of each person's personality. After that survey, they randomly assigned the roles of each person to become either a persuader or a persuade. Although for this project the dataset we use is mainly provided by this previous work, our model can adapt much better compared to their

model if the data is switched. In other words, we can utilize other datasets if we want to build different areas of persuasion. The example of the recorded conversation dataset is shown below:

A	B	C	D	E
	Unit	Turn	B4	B2
0	Good morning. How are you doing today?	0	0	20180904-045349_715_live
1	Hi. I am doing good. How about you?	0	1	20180904-045349_715_live
2	I'm doing pretty good for a Tuesday morning.	1	0	20180904-045349_715_live
3	Haha. Same here, but it really feels like a Monday.	1	1	20180904-045349_715_live
4	Ugh yes it does!	2	0	20180904-045349_715_live
5	I can not believe how warm it is already.	2	1	20180904-045349_715_live
6	Where are you from?	3	0	20180904-045349_715_live
7	I am from the Midwest. What about you?	3	1	20180904-045349_715_live
8	I'm from the South East. It's always warm here.	4	0	20180904-045349_715_live
9	Oh, yep. You are definitely in for warm weather, which is	4	1	20180904-045349_715_live
10	We're about to get hit by a tropical storm.	5	0	20180904-045349_715_live
11	I heard that some bad weather was going to be coming. I	5	1	20180904-045349_715_live
12	Me too. It's just part of living on the Gulf. You have to be	6	0	20180904-045349_715_live
13	Yes, I am sure you get a lot of storms.	6	1	20180904-045349_715_live
14	We do. I guess I should get into what this chat is suppose	7	0	20180904-045349_715_live
15	I have heard about them. What do you like about them?	7	1	20180904-045349_715_live
16	I like that they're committed to helping children in need.	8	0	20180904-045349_715_live
17	Yes, I also like what they do. They are a great organizati	8	1	20180904-045349_715_live
18	I'm planning on donating most of my earnings today. Wou	9	0	20180904-045349_715_live
19	I would like to donate \$0.20. Would that help?	9	1	20180904-045349_715_live
20	Yes it would. Any little bit helps. Thank you for your dona	10	0	20180904-045349_715_live

As we can see here the B4 column contains 0 and 1 values inside, while 0 represents the persuader and 1 represents persuadee. The B2 column recorded each id of the conversation, and the Unit column is the detail of each sentence.

This is the raw data we use but we haven't processed it. Our logic of process with this dataset firstly creates a vocabulary set and loads all the words in our corpus and then trim the infrequently seen words, this is called the Bag of Words. Then we will do a basic preprocess with those words. For example, turn all of the letters to lowercase and delete non-letter characters then convert them to the input-target pair. In order to make our model understand, we have to accommodate sentences in the same batch. By adding tokens such as (<SOS>, <EOS>, <PAD>), each sentence in our dataset will have the same length and hence the model will understand where is the start and where to end. Below is the dataset after processing:

input	target
<SOD>	Would you like to donate to a children's chari...
what is this charity about?	a non-governmental organization aht promotes ...
Developing countries is a broad category. Is t...	Syria, Thousands of kids die in just a quarter...
Where is the organisation's headquarters?	London, United Kingdom. If you care about chil...
I get mails and calls from different charities...	You don't have to take my word for it, you can...
Thanks for the web-page link. I checked it and...	I'm sure you've made some frivolous purchases,...
How can I donate to the organisation?	You can donate right through the website I pro...
Thanks for the info. Will do that	No problem and thank you for helping children ...
will I get a confirmation mail after the donat...	Yes, it will also include a subscription that ...
What is this subscription about?	It's a Save The Children eNews letter that pro...

Doing some statistics on our datasets, we eventually have the following table showing the aggregated stats of each term.

Number of pairs in raw data	11349
Number of pairs in processed data	5567
Number of words in BOW	8076

After these steps, our data will finally be ready to go, and we will start to build our model and train it based on our dataset.

4 Method

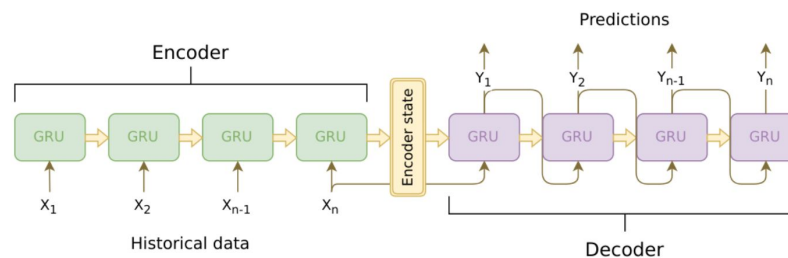
Traditionally, for the Chatbot focused on a certain area, people tend to use the template-based and retrieval-based method to generate sentences. The template-based method means that we need to write the response manually. And the retrieval-based method means that for every sentence user inputs, the system would choose the most likely one in our whole data corpus, which can only generate the sentences that have appeared. These two methods have proved that are useful in a restricted area like customer service, booking system, and also our goal-Persuasive Chatbot.

In our research, we explore the third natural language generation method -- the generative method, which means that could generate the sentence word by word. And also this method

works not really well as the above method but it is what we expect for Chatbot in the future. And if we use this method, it is really easy for us to apply our Chatbot to other data.

4.1 Seq2Seq Model

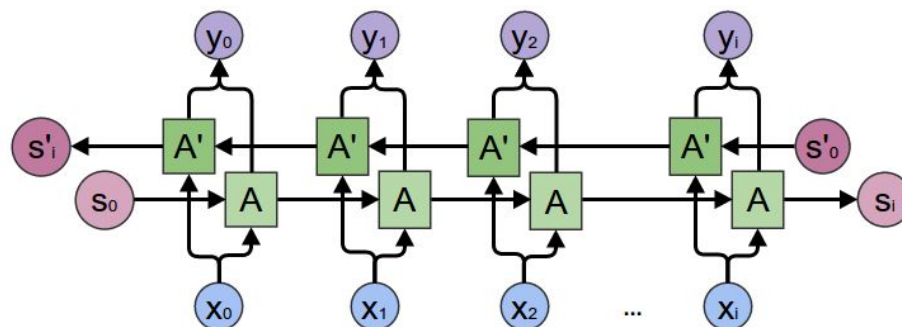
Sutskever et al.(2014)[3] found that when dealing with NLP problems if we use two RNNs, the model would work well. Here, the first RNN works as the encoder, which encodes a variable-length sequence to a context vector, which contains semantic information for the input sequence. And the second RNN works as the decoder, which takes in an input word and the context vector and predicts the words in output sequence one by one.



4.2 Encoder

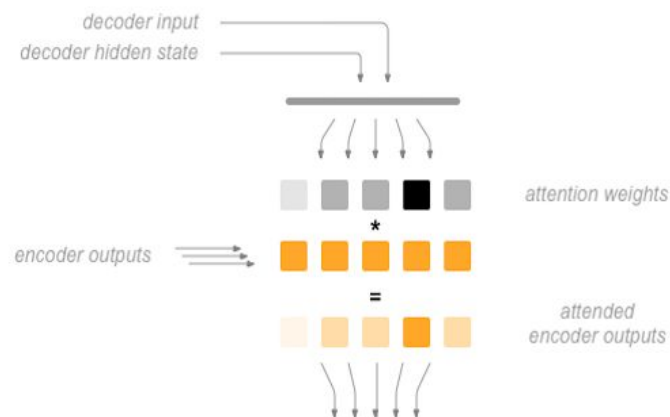
The encoder RNN handles one word at a time, and every time outputs an output vector and a hidden state vector. The hidden state vector would be used to handle the next time step's word. And output vector would be entered to the decoder to predict the output sentence.

And for our project, we would use a bidirectional RNN, which means that the input sentence would be fed in both normal sequence order and reverse order also. This way would decrease the bias of our model.

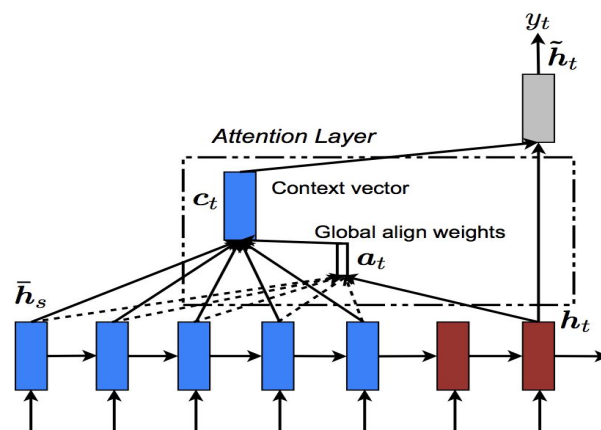


4.3 Decoder with Attention

The decoder uses context vector from the encoder part and the internal hidden state to generate the output sentence word by word. Since if we use context vector directly, it would cause information loss. In other words, when we generate each word, it mainly based on certain words from the input sentences, especially in long sentences. So here we would use the attention mechanism, which enables us to focus on some parts of the input context rather than on the whole context vector every time.

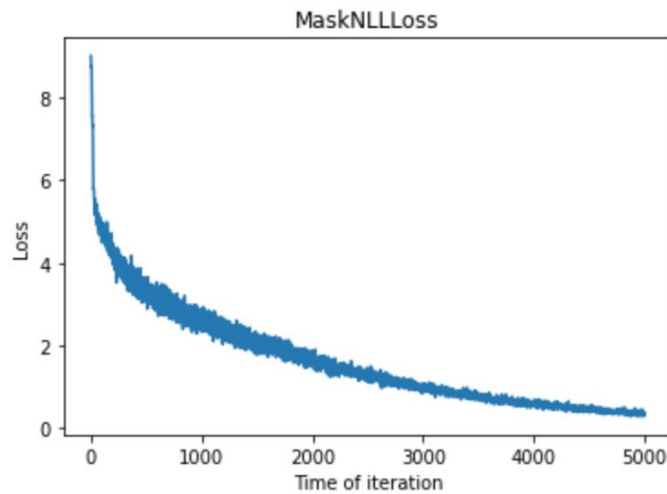


Here, we used Luong Attention(2015)[4], which focuses on Local Attention. Local Attention considers the encoder's hidden state from this time step.



5. Experiments

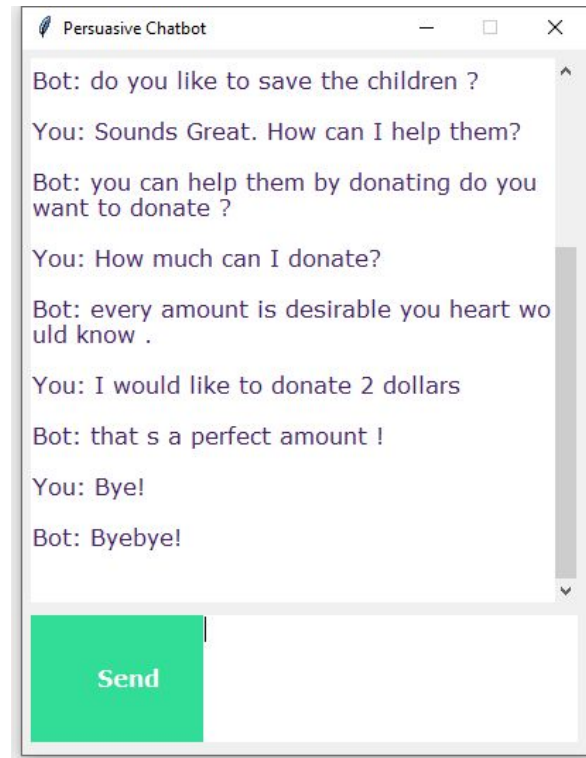
After applying data processing and modeling, the picture below displays the loss after training 5000 iterations. Here we use mask negative log-likelihood loss. Since we are dealing with padded sentences, we need to exclude the padding token in every sentence to calculate the difference between the output from decoder and target. And it is obvious that our model converges quickly and the final MaskNLLLoss is about 0.2.



6. System Overview

Our application doesn't have too much functionality other than talking with it. The program is really simple to use by firstly downloading the branch in our GitHub repository and then go to the directory where the package is downloaded. Now simply type `python evaluation.py` in the command prompt then it will run successfully. Also, make sure the required packages for python installed. Our mainly used package is PyTorch and tkinter.

The UI includes a "Send" button to send messages, an input text window to input what you want to talk with the chatbot, and a usual window to show the chatlog. We can see it below:



7. Conclusion

This project also gives us an idea of how to construct a format for future works. For instance, if someone tries to do a project with something new, this person must first find some related work that has been previously done by other people. This process will release a huge amount of work and by looking through the papers and codes, building upon such progress will help a lot. At first, we really lack this kind of experience of researching which leads us to some bad results. Eventually, we understand how important to do some related work research and then apply our ideas on it.

Building a persuasive chatbot is a really difficult project for us to do as we lack knowledge in deep learning and psychology. During this project, as mentioned above, we utilized so many online resources to finally grow up some degree of what we are trying to do with the deep learning method and how to build a chatbot as a beginner. This application is not the final version of what we are trying to build, with some limitations such as the personality analyzing and even some usual way to communicate with the user (not persuading them). We'd like to give this chatbot more functionalities by adding more datasets to our model and thus train this chatbot to become even stronger. Hopefully, if we have more time and resources, we want to build more areas of applications such as medical or insurance to our chatbot.

8. Supplementary Material

Github link: https://github.com/Sapphirine/Machine_with_Personality-Chatbot

Youtube link: <https://youtu.be/da8ayvIP2u0>

References

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- [4] Minh-Thang Luong, Hieu Pham and Christopher D.Manning. 2015 Effective Approaches to Attention-based Neural Machine Translation.